XII. *Some Obſervations on the Irritability of Vegetables.*

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Read February 14, 1788.

HAVING often heard that the ſtamina of the Barberry, *Berberis communis*, were endued with a conſiderable degree of irritability, I made the experiment in Chelſea Garden, May 25, 1786, on a buſh then in full flower. It was about one o'clock P. M. the day bright and warm, with little wind.

The ſtamina of ſuch of the flowers as were open were bent backwards to each petal, and ſheltered themſelves under their concave tips. No ſhaking of the branch appeared to have any effect upon them. With a very ſmall bit of ſtick I gently touched the inſide of one of the filaments, which inſtantly ſprung from the petal with conſiderable force, ſtriking its anthera againſt the ſtigma. I repeated the experiment a great number of times; in each flower touching one filament after another, till the tips of all ſix were brought together in the center over the ſtigma.

I took home with me three branches laden with flowers, and placed them in a jar of water, and in the evening tried the experiment on ſome of theſe flowers, then ſtanding in my room, with the ſame ſucceſs.

In order to diſcover in what particular part of the filaments this irritability reſided, I cut off one of the petals with a very fine

fine pair of ſciſſars, ſo carefully as not to touch the ſtamen which ſtood next it: then, with an extremely ſlender piece of quill, I touched the outſide of the filament which had been next the petal, ſtroaking it from top to bottom; but it remained perfectly immoveable. With the ſame inſtrument I then touched the back of the anthera, then its top, its edges, and at laſt its inſide; ſtill without any effect. But the quill being carried from the anthera down the inſide of the filament, it no ſooner touched that part than the ſtamen ſprung forwards with great vigour to the ſtigma. This was often repeated with a blunt needle, a fine briſtle, a feather, and ſeveral other things, which could not poſſibly injure the ſtructure of the part, and always with the ſame effect.

To ſome of the antheræ I applied a pair of ſciſſars, ſo as to bend their reſpective filaments with ſufficient force to make them touch the ſtigma; but this did not produce the proper contraction of the filament. The incurvation remained only ſo long as the inſtrument was applied; on its being removed, the ſtamen returned to the petal by its natural elaſticity. But on the ſciſſars being applied to the irritable part, the anthera immediately flew to the ſtigma, and remained there. A very ſudden and ſmart ſhock given to any part of a ſtamen would, however, ſometimes have the ſame effect as touching the irritable part.

Hence it was evident, that the motion above deſcribed was owing to an high degree of irritability in the ſide of each filament next the germen, by which, when touched, it contracts, that ſide becomes ſhorter than the other, and conſequently the filament is bent towards the germen. I could not diſcover any thing particular in the ſtructure of that or any other part of the filament.

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This irritability is perceptible in ſtamina of all ages, and not merely in thoſe which are juſt about diſcharging their pollen. In ſome flowers which were only ſo far expanded that they would barely admit a briſtle, and whoſe antheræ were not near burſting, the filaments appeared almoſt as irritable as in flowers fully opened; and in ſeveral old flowers, ſome of whoſe petals with the ſtamina adhering to them were falling off, the remaining filaments, and even thoſe which were already fallen to the ground, proved full as irritable as any I had examined.

From ſome flowers I carefully removed the germen, without touching the filaments, and then applied a briſtle to one of them, which immediately contracted, and the ſtigma being out of its way, it was bent quite over to the oppoſite ſide of the flower.

Obſerving the ſtamina in ſome flowers which had been irritated returning to their original ſituations in the hollows of the petals, I found the ſame thing happened to all of them ſooner or later. I then touched ſome filaments which had perfectly reſumed their former ſtations, and found them contract with as much facility as before. This was repeated three or four times on the ſame filament. I attempted to ſtimulate in the midſt of their progreſs ſome which were returning, but not always with ſucceſs; a few of them only were ſlightly affected by the touch.

The purpoſe which this curious contrivance of nature anſwers in the private œconomy of the plant, ſeems not hard to be diſcovered. When the ſtamina ſtand in their original poſition, their antheræ are effectually ſheltered from rain by the concavity of the petals. Thus probably they remain till ſome inſect coming to extract honey from the baſe of the flower, thruſts itſelf between their filaments, and almoſt unavoidably touches them in the moſt irritable part: thus the impregnation of the germen is performed; and as it is chiefly in fine ſunny weather that inſects are on the wing, the pollen is alſo in ſuch weather moſt fit for the purpoſe of impregnation. It would be worth while to place a branch of the Barberry flower in ſuch a ſituation, as that no inſect, or other irritating cauſe, could have acceſs to it; to watch whether in that caſe the antheræ would ever approach the ſtigma, and whether the ſeeds would be prolific.

I have been the more particular in theſe obſervations upon the Barberry, becauſe although ſeveral authors mention the irritability of its ſtamina, none, that I can find, have related in what part of the ſtamina this property reſides, or the purpoſe it ſerves; at leaſt they have not purſued their inquiries with any great degree of accuracy, but ſeem moſtly to have copied one another. GMELIN, who has written a diſſertation expreſſly on the irritability of vegetables, has ſcarcely any thing new on the ſubject; the chief part of his work is a catalogue of plants which he found *not* to be irritable.

The Barberry is not the only plant which exhibits this phænomenon. The ſtamina of *Cactus Tuna*, a kind of Indian Fig, are likewiſe very irritable. Theſe ſtamina are long and ſlender, ſtanding in great numbers round the inſide of the flower. If a quill or feather be drawn through them, they begin in the ſpace of two or three ſeconds to lie down gently on one ſide, and in a ſhort time they are all recumbent at the bottom of the flower. The motions in *Dionæa muſcipula*, *Mimoſa ſenſitiva* and *pudica*, are too well known to be mentioned here. A ſimilar phænomenon has been obſerved, where indeed an obvious botanical analogy would lead one to expect it, in the *Droſera*.

See Dr. WITHERING's Botanical Arrangement of Britiſh Plants. All theſe movements are, I think, certainly to be attributed to irritability. We muſt be careful not to confound them with other movements, which, however wonderful at firſt ſight, are to be explained merely on mechanical principles. The ſtamina of the *Parietaria*, for inſtance, are held in ſuch a conſtrained curved poſition by the leaves of the calyx, that as ſoon as the latter become fully expanded, or are by any means removed, the ſtamina, being very elaſtic, fly up, and throw their pollen about with great force. I have lately obſerved a ſimilar circumſtance in the flowers of *Medicago falcata*. In this plant the organs of generation are held in a ſtraight poſition by the carina of the flower, notwithſtanding the ſtrong tendency of the infant germen to aſſume its proper falcated form. At length, when the germen becomes ſtronger, and the carina more open, it obtains its liberty by a ſudden ſpring, in conſequence of which the pollen is plentifully ſcattered about the ſtigma. The germen may at pleaſure be ſet at liberty by nipping the flower ſo as gently to open the carina, and the ſame effect will be produced.

As the foregoing experiments ſhew vegetables to poſſeſs irritability in common with animals, ſo there are plants which ſeem to be endued with a kind of ſpontaneous motion. LINNÆUS having obſerved that the Rue moves one of its ſtamina every day to the piſtillum, I examined the *Ruta chalepenſis*, which differs very little from the common Rue, and found many of the ſtamina in the poſition which he deſcribes, holding their antheræ over the ſtigma; while thoſe which had not yet come to the ſtigma were lying back upon the petals, as well as thoſe which, having already performed their office, had returned to their original ſituation. Trying with a quill to ſtimulate the ſtamina, I found them all quite devoid of irritability. They are ſtout, ſtrong, conical bodies, and cannot, without breaking, be forced out of the poſition in which they happen to be. The ſame phænomenon has been obſerved in ſeveral other flowers; but it is no where more ſtriking or more eaſily examined than in the Rue.

I could wiſh to find an inſtance of this ſpontaneous motion combined with irritability in one and the ſame plant; but, I confeſs, I do not know one. From analogy I ſhould think it not impoſſible that the *Dionæa muſcipula*, and perhaps the *Droſeræ*, may have the ſame motion in their ſtamina as the *Ruta*, *Parnaſſia*, and *Saxifraga*, while their leaves poſſeſs irritability. But if this be the caſe, the ſeats of theſe two properties, being ſo different and remote from each other, ſhould ſeem to have as little connexion as if in two different plants. There ſtill remains then this difference between animals and vegetables, that although ſome of the latter poſſeſs irritability, and others ſpontaneous motion, even in a ſuperior degree to many of the former, yet thoſe properties have hitherto in animals only been found combined in one and the ſame part. Even *Sertulariæ* are not an exception to this obſervation. The greater part of their ſubſtance, indeed, reſembles that of plants in being indefinitely extended, and in wanting irritability and ſpontaneous motion. But their animated flowers or polypes, in which the eſſence of their being reſides, are endued with both theſe properties in an high degree.

I know it is the opinion of ſome philoſophers that a certain degree of irritability muſt pervade every part of vegetables, as the propulſion of their fluids cannot well be conceived to be accompliſhed by any other means. In a converſation on this ſubject with the celebrated M. Bonnet, of Geneva, he informed me, that he is ſtrongly of this opinion; and that he ſhould not deſpair, by throwing acid or other ſtimulating injections into the veſſels of ſome plants, of ſeeing with a microſcope at once the propulſion of the ſap, and the contractions by which it is performed. He urged me, with that amiable enthuſiaſm for which he is remarkable, to purſue the inquiry. Whether I do ſo or not, I think the idea too intereſting to be kept to myſelf, and ſhould be glad to ſee it realized by any one who has time and abilities for ſuch inveſtigations, who has accuracy and coolneſs in making his experiments, as well as fidelity and impartiality in recording them.

I cannot conclude this Paper without taking notice of another very curious property which vegetables ſeem to poſſeſs in common with animals, although certainly in a very inferior degree: I mean, that property, to uſe the words of Mr. HUNTER, who has ſtudied this principle to a vaſt extent in the animal œconomy, by which their conſtitution is capable only of a certain degree of action conſiſtently with health; when that degree is exceeded, diſeaſe or death is the conſequence. It is only by the help of this principle that I can explain why many plants reſiſt a great degree of cold for ſeveral winters before flowering; but, after that critical event, they periſh at the firſt approach of cold, and can by no art be preſerved ſo as to ſurvive the winter. But a more curious inſtance is that mentioned by LINNÆUS, without an explanation, in his Diſſertation on the Sexes of Plants, of the long duration of the piſtilla in the female hemp, while unexpoſed to the male pollen; whereas thoſe to which the pollen had acceſs immediately faded and withered away. In this caſe, I cannot help thinking, that in thoſe piſtilla on which the pollen had acted, and which conſequently had performed the function for which they were deſigned, the vital principle was much ſooner exhauſted than in thoſe which had known no ſuch ſtimulus. It is, perhaps, for the ſame reaſon that double flowers, in which, the organs of generation being obliterated, no impregnation can take place, laſt much longer in perfection than ſingle ones of the ſame ſpecies, as is notoriouſly the caſe with Poppies, Anemonies, &c. In ſingle Poppies the corolla falls off in a few hours; but in double ones it laſts ſeveral days; and this may poſſibly, combined with other obſervations, lead to a diſcovery of the real uſe of the corolla of plants, and the ſhare it has in the impregnation, about which there has yet been no probable conjecture.